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THE SOUTH'S CONTRIBUTION TO SCIENCE[1]

By Dr. EMMETT B. CARMICHAEL

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THE general impression has been that most of the scientists of the United States have come from the northern and eastern sections, with the exception of a few, who have come from the western part of the country. On careful investigation, however, it was discovered that a great number of distinguished men of science have come from the South. There are perhaps two main reasons for such an erroneous impression: (1) the after-effects of the Civil War, and (2) the accumulation of the wealth of the nation in the northern and eastern parts of the country. Since war has a tendency to suppress the normal development of the conquered land, we might have expected that progress of all sorts, especially scientific progress, would have been delayed. And since many recent scientific achievements have come from institutions which have had the necessary capital for materials and equipment, it would be quite logical to think that the lack of wealth in the South would have had a curbing effect on interest in science. But regardless of the Civil War and this centralization of wealth of the nation, there have been many investigators of the South who have merited national and, in some instances, international recognition.

Since this paper is an attempt to give a brief survey of the whole South's contribution to science, of course, only some of the most important efforts can be included. I shall mention not only contributions made by men who were born and wholly educated in the South, but I shall mention also the scientific labors of those who were born and even educated in the North, but who were undoubtedly strongly influenced through teaching or living in the South.

This study naturally begins with the consideration of that well-known, beloved friend of birds, John J. Audubon, of Louisiana (1780–1851). He painted pictures of birds during his leisure hours and, since he was a poor man, he had to make several business

[1] Address of the retiring president of the Alabama Academy of Science, University, Alabama, March 13, 1931.

ventures in order to obtain enough money to continue his ornithological work. At first, he represented the birds suspended as dead game, but later portrayed them in life-like positions. In 1826, he sailed for England and Scotland and during a three-year stay secured enough subscribers to warrant the publication of his work. His pictures of the birds were life size and naturally attracted wide attention. It took about ten years to engrave and print the "Birds of America" and the "Ornithological Biography," the two works which contain Audubon's chief contributions. Audubon was noted for his simplicity, kind-heartedness, love of nature, love of youth and friendliness to humanity. In spite of many hardships, poverty and want, Audubon persevered until success crowned his efforts.

In the field of botany Alabama has given us an investigator, B. M. Duggar, who has been actively engaged in teaching and research for thirty-five years. During this time he has served two Southern universities and is at present located at the University of Wisconsin. He is the author of three works and has reported many articles on research. He has been editor of one journal and is assistant editor of another at present. Another botanist, W. H. Brown, of Richmond, Virginia (professor of botany at the University of the Philippines from 1915 to 1924), should be mentioned. He was plant physiologist of the Bureau of Science, Manila, from 1911 to 1923, and has been the director since 1924. He is the author of four works and numerous botanical publications. Brown has been editor of the *Philippine Journal of* Science since 1924.

Zoology, often associated with botany, is a subject that has not been neglected by Southerners. W. K. Brooks, of Cleveland, Ohio, born 1848 and died 1908, was professor of zoology at Johns Hopkins from 1877 until his death. He spent several summers studying the fauna in North Carolina and in Virginia, and was quite influential in the cultivation and development of the oyster industry. H. H. Newman, of Alabama, was professor of zoology and embryology at the University of Texas from 1908 to 1911, and has been professor of the same subjects at the University of Chicago since the latter date. He served as dean of the colleges of science at the University of Chicago from 1915 to 1922. He is the author of several works and is especially noted for his investigations on twins and twinning. Newman is editor of "The Nature of the World and of Man." Another distinguished zoologist is T. H. Morgan, of Kentucky, who directed the work that has led to the discovery of the mechanism of heredity. He has published numerous papers on various phases of heredity. Yet another famous zoologist is R. E. Coker, of South Carolina, who received all his training in the South, served in various capacities with the U. S. Bureau of Fisheries from 1900 to 1922. He has been professor of zoology at the University of North Carolina since 1922. He is the author of various reports and papers relating to barnacles, turtles, oyster culture and mussels.

It was South Carolina that gave us an eminent naturalist, W. Ravenel, who became connected with the U. S. Fish Commission in 1883, and has served in several responsible posts. He has been secretary of the Smithsonian Institution and has served as director of arts and industries in the U. S. National Museum since 1925.

A paper of this kind would not be complete without mentioning Eugene A. Smith (1841–1927), of Autauga County, Alabama, who was the second state geologist of Alabama and served from 1873 until his death. He was trained as a chemist and, in fact, taught chemistry at the University of Mississippi for three years before coming to the University of Alabama in 1871 as professor of geology and mineralogy. Beginning with the year 1874, he taught chemistry also and continued working with three subjects until 1890. He was made professor emeritus in 1913 and thus was able to devote all his time to the geological survey of Alabama. He was responsible for the location of cement and other industrial plants in his state. Smith was an interesting writer, and his bibliography contains over one hundred entries. Another geologist, T. W. Vaughan, of Jonesville, Texas, graduated from Tulane in 1889. He was engaged in geologic and paleontologic researches with the U. S. Geological Survey for twenty-nine years. He was geologist in charge of coastal plain investigations from 1907 to 1923 and has been senior geologist since 1924. Vaughan has been director of the Scripps Institution of the University of California, La Jolla, California, since 1924. He is the author of several works and has published numerous articles on geology, paleontology, oceanography and recent corals.

The field of chemistry seems to have been quite attractive to the youth of the South, as several distinguished investigators have come from this section. Charles Baskerville (1870–1922), of Noxubee County, Mississippi, was one of those inspired individuals. He received his education from four Southern universities and taught at the University of North Carolina for several years. In 1904 he moved to New York; there he became director of the chemical laboratory of the College of the City of New York and held this position until death. His earlier researches were with the rare earths, and he discovered the chemical elements, carolinium and berzelium. Baskerville was a leader in the American Chemical

Society, especially in the New York section. B. B. Ross (1864–1930), of Tuskegee, Alabama, is well known to many of us as an inspiring teacher and chemist. Ross received his first experience as a teacher at Louisiana State University from 1887 to 1893. He served as state chemist and professor of chemistry thirty-seven years. He served Auburn as dean of science for twenty-two years. Ross made numerous contributions on the chemistry of sugars and the analysis of fertilizers. Another eminent chemist, H. C. Jones (1865–1916), of New London, Maryland, received his education in the South and taught physical chemistry at Johns Hopkins from 1895 until his death. Being an untiring investigator, he published many articles, among which were several on absorption spectra of solutions, viscosity of solvents and conductivity of salts and acids. Jones was associate editor of three chemical journals. Ira Remsen (1846–1927), of New York, N. Y., became professor of chemistry at Johns Hopkins in 1876, and was director of the chemistry laboratory for thirty-two years. He later became president of that institution and served in that capacity for one year; he was made president and professor emeritus in 1913. Remsen had the honor of being president of several scientific bodies, among which was the National Academy of Sciences from 1907 to 1913. After receiving his education in the South, W. R. Orndorff (1862–1928), of Baltimore, Maryland, became professor of chemistry at Cornell and taught both organic and physiological chemistry at that institution until his death. Orndorff contributed numerous articles of original research to several of the chemical journals.

There are certain living chemists whom it would be interesting to discuss fully; however, for the purpose of this paper it is sufficient to give only a partial list of their contributions. C. H. Herty, of Georgia, taught chemistry at his state university and at the University of North Carolina. He is known for his original investigations, especially those on the collection of turpentine and pitch from the pine trees; he is noted, too, for his contributions to the paper industry. He was editor of the *Journal of Industrial and Engineering Chemistry* for several years. Herty is a past president of the American Chemical Society. J. F. Norris, of Maryland, was professor of chemistry at Vanderbilt University for a short period and has been professor of chemistry at the Massachusetts Institute of Technology since 1916. He has written text-books and is the author of numerous papers on chemical subjects. Norris also is a past president of the American Chemical Society. H. C. Sherman, of Virginia, has been professor of chemistry at Columbia since 1905. He has contributed largely to the chemistry of food and nutrition. Sherman is a past president of the American Society of Biological Chemists. S. C. Lind, of Tennessee, served as physical chemist of the U. S. Bureau of Mines for several years and then as chief chemist. He has been director of the school of chemistry, University of Minnesota, since 1926. He is assistant editor of two chemical journals. Lind has received the Nichols Medal for his work on chemical activation by alpha particles. C. S. Hudson, of Georgia, is chief chemist of the U. S. Bureau of Standards. Hudson has received the Nichols Medal and the Willard Gibbs Medal for his researches on the structure of sugars. G. W. Carver, of Missouri, who was awarded the Spingarn Medal in 1923, is director of the department of agricultural research, Tuskegee Institute.

It is interesting to note that the first professor of physics at Johns Hopkins, Henry A. Rowland (1848–1901), of Honesdale, Pennsylvania, received his appointment on the same day that Remsen was made professor of chemistry at that institution. Rowland remained in the chair of chemistry for a quarter of a century and became famous because of his work on the mechanical equivalent of heat. G. B. Pegram, of North Carolina, has been professor of physics at Columbia University since 1909. He has been dean of the School of Mines, Engineering, and Chemistry since 1918 at the same institution. Fred Allison, of Virginia, has recently announced the discovery of element 87. Allison has been professor of physics at Alabama Polytechnic Institute for several years.

The science of mathematics is closely associated with physics and Archibald Henderson, of Salisbury, North Carolina, has been connected with his alma mater, his state university, most of the time since 1899, and has been head of the department of mathematics since 1920. And R. D. Carmichael, of Goodwater, Alabama, is one of the representatives of that field who should not be overlooked. He has taught at the University of Indiana and the University of Chicago, and has been professor at the University of Illinois since 1915. Carmichael has been associate editor and editor of two mathematical journals and has been a constant contributor of original articles.

Again, it is Alabama that has given a noted son, W. L. Sibert, who served as engineer in charge of the eastern part of the Isthmian Canal. He built the Gatun Locks and Dam and excavated the channel from Gatun to the Atlantic Ocean. He was chief engineer of the Mobile Docks, which were recently completed. During the World War, Sibert organized the Chemical Warfare Service and became the director. M. S. Sloan, of Mobile, Alabama, received his education at Alabama Polytechnic Institute and has served in various capacities as engineer for several

electrical concerns and is president of the Brooklyn Edison Co., Inc. W. H. Browne, of Baltimore County, Maryland, received his education in the South and did consulting work in electrical engineering for several years. He taught electrical engineering at Nebraska and Illinois and then in 1908 became professor of this subject and physics at North Carolina State College, where he has been head of the department of electrical engineering since 1916. A. S. Langsdorf, of St. Louis, received his training at Washington University. He was called to the chair of electrical engineering at the same school in 1901. He was appointed dean of the school in 1910 and served in that capacity for ten years. Langsdorf has been director of the department of industrial research at Washington University since 1926.

The accomplishments of inventors do not pertain to any one branch of scientific endeavor; yet it is interesting to note that the South had a marked influence on Eli Whitney, the Yankee schoolmaster from Massachusetts. Whitney had never seen a cotton seed until he came to Georgia to tutor some children. When he arrived, the position had been filled. He then accepted the invitation of the widow of General Nathanael Greene to make her place at Mulberry Grove his home while he studied law. Since he had shown his mechanical ability in other matters on previous occasions, Mrs. Greene asked Whitney to help devise some mechanical means of separating the cotton wool from the cotton seed. Whitney built the first cotton gin and later patented it.

In the multiple field of the medical sciences, there have been so many great men that the logical order of review becomes a problem at this point. It has long been considered that anatomy should come first, due to seniority, if not to alphabetical place, and we shall accept it as our first topic of the medical sciences. W. E. Horner (1793–1853), of Warrenton, Virginia, served as army surgeon in the War of 1812 and later practiced medicine for a short while in his home town. He became prosector of anatomy in the University of Pennsylvania, and finally accepted the chair of anatomy in the same institution. He discovered the *tensor tarsi muscle* which bears his name, and contributed several original papers on anatomical subjects. Next we shall take up the study of the contributions of John D. Godman (1794–1830), of Annapolis, Maryland. He practiced medicine in his state and in Pennsylvania. Godman taught anatomy in three schools, one of them being the University of Maryland. He became the editor of the *Western Quarterly Reporter of Medical, Surgical, and Natural Sciences,* the first medical journal to be published west of the Alleghenies. Godman also assisted in editing the *Philadelphia Journal of Medical Sciences.* We might add the name of Jeffries Wyman (1814–1874), of Chelmsford, Massachusetts, even though he spent the major portion of his scientific career at Harvard, his alma mater. A few years after graduating he accepted the chair of anatomy and physiology at Hampden-Sidney College, Virginia. Wyman was another prolific writer and wrote over two hundred articles.

There are several living anatomists who should be included in this paper. Charles R. Stockard, of Mississippi, has edited three journals and has personally been a constant contributor. Stockard has been professor of anatomy at Cornell for twenty-two years. Irving Hardesty, of North Carolina, has been professor of anatomy at Tulane for the same length of time. Hardesty has published numerous papers on the nervous system. Ross G. Harrison, of Pennsylvania, taught anatomy at Johns Hopkins for eleven years and has been at Yale for twenty-four years as professor of anatomy and biology. His name is usually connected with the work on the growth of nerve fibers. He has edited the *Journal of Experimental Zoology* since 1903. Warren H. Lewis, of Connecticut, has been professor at Johns Hopkins since 1904. He has been research associate at the Carnegie Institution of Washington since 1919, and has published many articles.

Since surgery is so closely associated with anatomy, it is fitting to discuss it next. Regardless of time or place, the great southern gynecologist, Ephraim McDowell (1771–1830), of Rockbridge County, Virginia, stands second to none among surgeons He was educated in the South except for the part of his medical work which he took in Edinburgh. He practiced medicine in Danville, Kentucky, and in 1809 he successfully performed the operation for extirpation of the ovary, the first on record, and in consequence he acquired European celebrity. He performed this operation thirteen times, and had eight recoveries. His first patient lived for thirty-three years after the operation. To McDowell has been given the credit for putting ovariotomy upon a permanent basis. James Marion Sims (1813–1883), of Lancaster County, South Carolina, settled in Alabama and became interested in operative gynecology. He is noted for his contributions to uterine surgery, both mechanical and operative, his name being associated with the peculiar lateral posture, which he employed during his examinations, Sims' position. He is especially remembered for his success in operating for vesicovaginal fistula. He was the founder of the State Hospital for Women in New York. The work of Sims was continued by his able assistants, Thomas A. Emmet, of Virginia, and Nathan Bozeman, of Alabama.

There are several other gynecologists who have made worthy efforts that deserve mention. John King, of South Carolina, in 1816, operated successfully in a case of abdominal pregnancy and saved the life of both the mother and child. He is the author of the first book on "An Analysis of the Subject of Extra-uterine Foetation, and of the Retroversion of the Gravid Uterus." William Baynham (1749–1814), of Virginia, operated twice for extra-uterine pregnancy and was successful in both instances. Josiah Clark Nott (1804–1873), of Columbia, South Carolina, in 1844 described the condition which was later called coccygodynia. He was one of the first to suggest the "mosquito theory" in reference to the transmission of yellow fever, some fifty years before Reed and his commission assembled in Cuba. We, of Alabama, feel grateful to Nott because he was instrumental in organizing the Medical College of Alabama at Mobile, which was the forerunner of our present School of Medicine. T. G. Thomas, of South Carolina, performed the first vaginal ovariotomy in 1870. Robert Battey, of Georgia, in 1872, was the first to suggest the excision of the uterine appendages for such non-ovarian conditions as neuroses and painful menstruation. F. C. Hammond, of Georgia, has served both as professor of gynecology and as dean of the medical department, Temple University. To McDowell and Sims, however, goes the credit for founding modern operative gynecology. Another surgeon, William Gibson (1788–1868), of Baltimore, Maryland, finished his education at Edinburgh. He was the first to successfully perform the Caesarean operation twice with success to both mother and child on the same patient, the patient living for fifty years after the first operation. His son, Charles Bell Gibson, became professor of surgery in two Southern schools and was made surgeon-general when the state of Virginia seceded.

Anesthesia was introduced in cases of surgery by Crawford W. Long (1815–1878), of Danielsville, Georgia, who noted the anesthetic effects of ether and used it quite extensively in surgery during 1842 and 1843. He was not aggressive and ambitious and did not publish his results. Documentary evidence, however, has been found which clearly proves that Long was the originator of anesthesia in surgery.

Samuel D. Gross (1805–1884), of Easton, Pennsylvania, was professor of surgery at Louisville for sixteen years before going to Jefferson Medical College in 1856. He invented new instruments and introduced deep stitches in wounds of the abdominal wall. He was an interesting writer, and we are especially indebted to him for his biographies of some of the leading medical men. Gross wrote also a system of surgery in two volumes.

John A. Wyeth (1845–1922), of Missionary Station, Alabama, received his medical training at the University of Louisville. He organized and founded the first postgraduate medical school in the United States, the New York Polyclinic Medical School and Hospital. Wyeth was the first professor of surgery and president of the faculty.

Due to the breadth of the field that I have undertaken to cover, I can only list briefly the names and accomplishments of a few more of the Southern surgeons who have originated some particular method or technique. Charles McCreary, of Kentucky, was the first to excise the clavicle in an operation performed in 1813. Milton Anthony, of Georgia, excised the fifth and sixth ribs with a portion of gangrenous lung in 1821. Paul F. Eve, of Georgia, removed a large fibrous polyp from the base of the cranium in 1836. John M. Carnochan, of Georgia, removed the ulna with preservation of the arm function in 1853. J. T. Hodgen, of Kentucky, devised instruments and suspension splints for fracture of the femur and forearm that are still in use.

Another branch of medical science, pharmacology, has attracted a few men. Arthur S. Loevenhart (1878–1928), of Lexington, Kentucky, served as professor of that subject at two universities and as chief pharmacologist of the research division, Chemical Warfare Service, American University, in 1918. Loevenhart served as associate editor of the official organ of his field. Physiology is one of the sciences that is so closely associated with pharmacology that some schools include both subjects in one department. An investigator who has been professor of both subjects is W. D. Cutter, of New York. Cutter taught at the University of Georgia for several years. He has served as dean of the New York Post-Graduate School and is now dean of the School of Medicine of the University of Southern California. Henry Sewall, of Virginia, taught physiology for twenty-six years and is professor emeritus of the University of Colorado. Sewall has recently been awarded the Kober Medal for research work in tuberculosis. W. H. Howell, of Maryland, who has been on the faculties of three universities and been dean of the medical faculty of Johns Hopkins, is at present director of the School of Hygiene of the same university. Howell is a recognized leader in the field and was so honored at the Thirteenth International Physiological Congress in 1929. Isaac H. Manning, of North Carolina, has been professor of physiology at the University of North Carolina since 1901 and dean since 1905.

There is another branch of the sciences that has long been associated with physiology, but which has been given recognition as an individual subject only in comparatively recent years. I have reference to

biochemistry or physiological chemistry. I shall begin with Victor C. Vaughan (1851–1930), of Mt. Airy, Missouri. He taught chemistry in the department of medicine, University of Michigan, for thirty years and served as dean for an equal period. Vaughan is known for his work on poisonous alkaloids, ptomaines and cellular toxins. Walter Jones, of Maryland, was professor of physiological chemistry at Johns Hopkins from 1895 to 1927, at which time he was made professor emeritus. Jones has been an untiring investigator in nuclear chemistry. William J. Gies, of Maryland, taught at Yale and Columbia and was made professor emeritus of Columbia in 1929 after thirty-one years' service. He was secretary of the faculty of the College of Physicians and Surgeons from 1905 to 1921. He was the founder and editor of the *Proceedings of the Society for Experimental Biology and Medicine.* Gies has been assistant editor and editor of four other journals, and has contributed numerous original articles. P. A. Shaffer, of West Virginia, has been professor of biochemistry at Washington University since 1910 and was dean of the faculty of medicine from 1915 to 1919. J. F. McClendon, of Alabama, has been associated with the department of physiological chemistry at the University of Minnesota since 1914, and has been professor since 1920.

There are several pathologists of the South who have not only influenced the medical sciences by their own personal investigations but have also been influential because most of them have been directors of scientific institutions. Simon Flexner, of Kentucky, has taught at two universities and has been director of the Rockefeller Institute for Medical Research since 1903. Flexner's researches include work on venoms and various bacterial and pathological subjects. W. H. Manwaring, of Virginia, received his early training at the University of Chicago and then became connected with Indiana University and later with the Rockefeller Institute. Manwaring has been professor of bacteriology and experimental pathology at Stanford University since 1913. David Marine, of Maryland, who has been teaching at Columbia University, recently received the gold medal of the New York Academy of Medicine for his researches into the structure, function and diseases of the thyroid gland. Eugene L. Opie, of Virginia, served as professor and dean of Washington University, School of Medicine, and has been director of the department of pathology at the University of Pennsylvania for eight years. Newton Evans, of Missouri, taught pathology at the University of Tennessee and at the College of Medical Evangelists. Evans is dean at the latter institution. Milton C. Winternitz, of Maryland, was professor of pathology at Johns Hopkins and at Yale and has been dean of the School of Medicine at Yale for eleven years. Wade H. Brown, of Georgia, taught at two Southern universities before becoming connected with the Rockefeller Institute for Medical Research. William A. Evans, of Alabama, was professor at the University of Illinois for several years and is now professor of sanitary science at Northwestern University Medical School.

The men interested in medicine, clinical medicine and preventive medicine have been rather numerous, and it was a difficult task to select the individuals whom I shall discuss but briefly. Nathaniel Chapman (1780–1853), of Virginia, was professor of clinical medicine at the University of Pennsylvania for several years. He founded and edited the *Philadelphia Journal of the Medical and Physical Sciences,* later the *American Journal of the Medical Sciences.* Chapman was the first president of the American Medical Association. The cultivation of all three species of malaria was performed by C. C. Bass, of Mississippi, who has received several gold medals for his researches. Bass has served as professor of experimental medicine, director of the laboratory of clinical medicine and dean at the College of Medicine, Tulane. Manfred Call, of Virginia, a former dean at the Medical College of Virginia, is professor of medicine at the same school. James C. Flippin, of Virginia, another teacher of clinical medicine, served the University of Virginia as professor and is dean of the department of medicine. John N. Simpson, of West Virginia, organized the School of Medicine, West Virginia University, and became professor of medicine and dean. Robert Wilson, of South Carolina, has been associated with the medical college of his state since graduating in 1892. Wilson has been professor of medicine for twenty-seven years and dean for twenty-three years. Ross V. Patterson, of Louisiana, has been professor of medicine and dean of Jefferson Medical College for fifteen years. James S. McLester, of Alabama, was formerly professor of medicine at the Birmingham Medical College and has had the same title at the University of Alabama for twelve years. George C. Robinson, of Maryland, has been professor of medicine and dean of Washington University, Vanderbilt University and Cornell University. M. P. Ravenel, of South Carolina, has been professor of medicine at the University of Missouri and the director of the Public Health Laboratory since 1924. Alan M. Chesney, of Maryland, is another individual who has risen from the ranks in his alma mater. Chesney has been dean of Johns Hopkins since 1929. W. S. Leathers, of Virginia, was dean of the Medical School, University of Mississippi, for

twenty years and has been professor of preventive medicine, Vanderbilt University, since 1924.

I shall mention only a few representatives in some of the other medical sciences. Frank Vinsonhaler, of Missouri, has been professor of ophthalmology at the University of Arkansas since 1893 and is at present dean of the medical school. James M. H. Rowland, of Maryland, has been professor of obstetrics at the University of Maryland and dean of the Medical School since 1915. Henry A. Christian, of Virginia, has been professor of the theory and practice of physic for more than twenty years at Harvard. He served as dean of the same school for four years. In addition, Christian has been physician-in-chief to Peter Bent Brigham Hospital for twenty years. W. McKim Marriott, of Maryland, began his training as a biochemist at Washington University, but changed to pediatrics when called to Johns Hopkins. He later returned to Washington University as professor of pediatrics, and has been dean for several years. W. H. Frost, of Virginia, formerly with the Hygienic Laboratory at Washington, D. C., has been connected with the United States Public Health Service since 1913.

There have been some men, born in other places than the South, who have taught in the South and who should be listed in a paper of this nature. Certainly this report should contain the name of Sir William Osler (1849–1919), of Tecumseh, Ontario, who taught at Johns Hopkins from 1889 to 1905. Osler is noted also for his writings and is particularly remembered for certain of his biographical essays, one of which is "The Alabama Student," a portrayal of the character of Dr. John Y. Bassett, of Huntsville, Alabama. William H. Welch, of Connecticut, was professor of pathology at Bellevue Hospital Medical College from 1879 to 1884 and for the next thirty-two years at Johns Hopkins. Welch was dean of the medical faculty from 1893 to 1898, and was director of the School of Hygiene and Public Health from 1916 to 1926. Since 1926 Welch has been professor of the history of medicine at Johns Hopkins. William S. Thayer, of Massachusetts, was professor of clinical medicine at Johns Hopkins for several years and is professor emeritus of the same institution. Thayer has been a thorough investigator, and he made the first clinical notation of the third sound of the heart in 1908.

In order to show you further that the South has played a great part in furnishing directors for scientific groups, I shall make use of some statistics concerning the present deans of the medical sciences. The recent standard references list sixty-three of the seventy-five deans, and twenty-nine of these were influenced by the South to the following extent: Three were born in the North and received the doctor's degree in the South; six were born in the North and received the doctor's degree in the South and taught in the South before becoming deans; nine were born in the South and educated in the South, except for the work for the doctor's degree; eleven were born in the South and wholly educated in the South.

I know of no more fitting close for this paper than to summarize the works of the Southerners who played the principal part in the suppression of yellow fever. Virginia gave us the leader of this series of great scientific achievements, Walter Reed (1851–1902), who received his medical training in his state university. He was promoted to full surgeon with the rank of major in 1893 and became professor of bacteriology in the newly organized Army Medical School. Reed went to Cuba in 1900 as president of a commission to study yellow fever. The theory had been advanced by Josiah Clark Nott in 1848 that a mosquito was the agent for the transmission of the disease, but there was no scientific evidence in support of it. Reed determined to study the effect of the bite of the mosquito. Two of the commission and several enlisted men volunteered to submit to this experiment. Dr. Jesse W. Lazear (1866–1900), of Baltimore, who had offered himself as one of the first volunteers, succumbed to the fever, and his death was the only fatality during the experiments. Another one of the commission, James Carroll, suffered a very severe attack of the fever, but recovered.

The prevention of the disease was left to the chief sanitary officer in Havana, Major William Crawford Gorgas (1854–1920), of Mobile, Alabama. In less than seven months, Havana was free from the stegomyia mosquito, which had infested it for one hundred and fifty years. Gorgas was appointed the chief sanitary officer of the Panama Canal in 1904, and a member of the Isthmian Canal Commission in 1907. Due to his sanitary measures, it was possible to complete the canal, a project which France had failed to accomplish because of the ravages of yellow fever and other tropical diseases. Gorgas was made surgeon-general in 1915 and continued his sanitary work until his death. He was the recipient of several medals and his work was recognized by kings and governments throughout the world.

The above investigators, whom I have briefly mentioned, can be only an indication as to the type of scientist the South has produced or influenced. And this paper is but a short discussion of Southern men of science whose lives and works have become familiar to the writer through personal communication and through reading.

OBITUARY

SAMUEL WESLEY STRATTON

1861–1931

DR. SAMUEL WESLEY STRATTON died suddenly at his Back Bay home of coronary occlusion on October 18, at the age of seventy. He had just dictated a tribute to Thomas A. Edison, whose death occurred a few hours before. His tribute to Edison reads in part: "It seldom has fallen to the lot of any one man to be of such service to humanity. The world mourns that great benefactor." The tribute might very well have been written for Dr. Stratton.

Dr. Stratton was born in Litchfield, Illinois, July 18, 1861, the son of Samuel and Mary B. (Webster) Stratton. He was graduated from the University of Illinois in 1884 with the degree of bachelor of science, and afterward went through the usual steps from instructor to professor in physics in this institution. In 1892 he left his alma mater to become associate professor and later professor of physics at the University of Chicago, where he remained until 1901, when he was forty years old.

During these years he had gained a perspective not only in science but in its broader outlook. He was keenly interested in research. I remember, as a cub instructor and research worker at the University of Illinois, seeing some of his personal research material, such as a collection of orifices for the study of the laws of liquid flow, and other special equipment according to his own ideas. He was fascinated with the work of Michelson and throughout his life yearned to do similar work himself. At forty he was not marked as a genius either as a teacher or as a research worker, but he had made many friends and had extended his understanding of human nature and human values.

While he was a student at the university he lived meagerly with Frank A. Vanderlip, who has since become the well-known banker and philanthropist. Stratton worked in the machine shops to partly defray his expenses. He recognized these as a godfather and he never lost his fondness for machine shops or new developments in machine tools. His warmth for machines was somewhat akin to his unconscious warmth toward persons who had befriended him. All during his administration at the Bureau of Standards, he not only took pride in developing a most up-to-date and efficient shop, but he also had his own personal shop where he could handle and play with tools. Many times he retired to this as a retreat, as others would go to a mountain top. Even at the Massachusetts Institute of Technology he had his personal complete shop, and I have seen most estimable testimony in his work that in his last year his hands had lost none of their skill. In the early days he frequently entertained his shop force at dinner and in the evening. He always deprecated the loss of a skilled machine worker to the white collar class. Like Carlyle, he was aware that machine tools are basic in human contest with the forces of nature. He saw Michelson's continued dependency on the precision of his shop work.

His school friend, Mr. Vanderlip, became Assistant Secretary of the Treasury from 1897 to 1901; through his instrumentality Dr. Stratton was invited to formulate the project for the development of the weights and measures work, then under the control of the Treasury Department. Almost single handed he engineered through the enactment of March 3, 1901, which created the Bureau of Standards. This at once showed his native ability as a politician and statesman. He was, naturally, invited by Secretary Lyman J. Gage to become the first director. His vision of the usefulness of such a bureau was so clear that during his entire administration he was not handicapped by the organic act, setting forth the functions and scope of activity.

Dr. Stratton, like most great men, was modest, even approaching shyness. He did not like to give lectures or talks or to make a conspicuous appearance at public affairs, yet no task was shirked if it seemed important to the bureau. Organization was his genius. Quickly he learned the key men at the Capitol, their interests and their proper approach. He formed an intimate acquaintance with Eliott Woods, an able political figure, the superintendent of the Capitol, who figuratively gave him the keys to the back doors. Woods was a devotee of science, who found the subject a happy playground. He had a continuous set of demonstrations in a group of rooms, showing x-rays, Geissler tubes, spectra of various kinds, and similar exhibits with equipment surpassing that of many a college laboratory. Dr. Stratton assisted him in setting up many of these. Mr. Woods often invited the Senators, Congressmen and their wives to tea or evening receptions, when regular and special demonstrations would be staged. It is not surprising that these guests, many of whom had never seen a science laboratory, should be fascinated with the display of the forces of nature—more mysterious than those in detective stories. Moreover, Mr. Woods was a genial host and he never missed a good opportunity to say that such wonderful things were developed at the Bureau of Standards and, of course, giving more than faint praise to Dr. Stratton. With a Congress that was never science-minded, one can readily see the advantage of such interventions. Likewise, the clerk of the appropriations committee of the House became a

fast and useful friend to the bureau. From him was learned the proper course to steer appropriations, the idiosyncrasies of the members—and even good stories. I am sure it was a genuine friendship, for Dr. Stratton was accustomed to visit his burial place. He also became acquainted with the minor as well as the major clerks in the offices of the leaders. I remember his saying that sometimes he thought the Congressmen and Senators got more for their money in employees hired through patronage than could be obtained by any system of formal examination. He was a born democrat. He maintained a manner of respect toward these minor employees as he did toward his chauffeur, his cook or the head of another bureau. He seldom intruded on the time of the leaders like Uncle Joe Cannon, but he could always get their attention when it seemed a matter of public interest. The demands of these for special favors from the bureau were rare, although the director treated every request with utmost courtesy. If it were a personnel appointment of doubtful value, he would, perhaps, visit the Senator or Congressman, and express appreciation for thinking of the bureau, and then explain the nature of the work and the necessary qualifications and the great difficulty of finding suitable candidates. Thus the conversation revealed the candidate's deficiency and the request was usually withdrawn; the institution was a little better understood on the Hill and the director lost no ground. Needless to say, he made it known that all opportunities for service within the bureau's field were courted.

His human approach to a formal hearing before the appropriations committee was interesting. I remember on one occasion he took some samples of optical glass and other pretties and laid them out on the table. The committeemen thought they understood these and enjoyed the entire story. The ice was broken and the hearing proceeded easily.

Dr. Stratton's heart and home was the Bureau of Standards. His dynamo of energy and ability was running there as constantly almost as the one in the power plant. He started many researches and took almost as much personal interest in dozens of researches as if he were personally directing them. He was busy getting a new testing machine or other equipment, and after that busy finding a suitable means of housing it. The bureau was always needing either equipment to fill out some building or department or some building or land to house the equipment. Thus it grew. The director was ready to advance on many fronts and he advanced where the way was open and reinforced the intrenchments where the way seemed closed. But he was faithful to Congress, as he was also faithful to the bureau and its staff.

Likewise the director was continually on the lookout for worthy research and testing work, and so the staff always seemed overburdened. Consequently he was ever on the lookout for able and qualified men. He was ever alert either to give a research opportunity to a man or to get a man for an opportunity. The bureau loomed up to him like a mountain, so that there rarely seemed to be any equally good place for an effective scientist. His hold on his staff was almost uncanny. Many a man with full intention of leaving could not make the getaway. When I was acting director one of the division chiefs came into the office with his resignation all written and final. He admitted my accusation that he would not have had the courage to submit his resignation to Dr. Stratton.

His personal characteristics counted as much for his leadership as did his understanding of men. I became acquainted with him during the war when it was frequently necessary to seek assistance from the bureau in many ways. He was always eager to render help and if he saw the necessity that certain work should be done he would go ahead, forgetting about costs and pay and the like. It was of much more concern to do worth-while work than it was to do a good accountants' job. When my war work was over, I was standing shaking hands with him and expressing a quick, informal appreciation for the help of the bureau. Within less than a minute he completely surprised me with an invitation to become his assistant. He explained that the position had been authorized for three years, but that he had not found the right man, and further, I could do him great service. Beyond that there was no urging, but he knew I was hooked, and after taking a month that seemed like playing between life and death I landed. Within a few months I was designated as acting director in his absence. He would usually evaluate a man in his first five-minute contact and rarely found a material revision necessary. In case of such revision, it was just too bad for the man. There was never any criticism and rarely any direct instruction to those he trusted. His intuition was remarkable. The purpose of the visitor to his office was usually clear before the first sentence was completed. This gave him advantage as well as pleasure. Sometimes he could get a good laugh when the game went against him.

Dr. Stratton had an unusual personal interest in his staff, possibly because he had no family of his own. At Christmas there was a Christmas tree and presents for the children of the staff members, and in the late spring he gave a children's party. There was a merry-go-round, a live pony to ride, an organ grinder and a monkey, pink lemonade and balloons. Dr. Stratton observed what went on. He thought children much more fun than monkeys. His pleasure lasted long after the party was over. It was a joy

to him to have one of his secretaries married to one of his research staff right in his own home. He had an especially keen interest in the younger folk. Remembering his own appreciation of work during his college days, there was instituted a system of apprenticeship for ambitious boys, so that they could continue their education. He could not understand those boys who wanted a job at the bureau and who did not continue to take advantage of the educational possibilities. It reminded him of the nice slick pigs that quickly transformed into scraggly or razorback hogs. He had a wealth of such illustrations that seemed to me rather better than the ones by Shakespeare, and he very rarely used the same one twice. Some of these he manufactured himself, others he received from his friend at the meat market where he usually did his daily shopping. His democracy was somewhat like that of our former President who obtained stories from his cobbler. His educated and distinguished pals know where he got some of the others.

Among his bosom friends were the dearest souls imaginable, such as Brashear and Swasey, whom he first joined through common interest in optics and machine work. He also had a particular fondness for the quiet and modest research workers. Several afternoons a week he would walk around visiting these men and bringing a cheer that was invaluable. On his visits to the bureau during the interregnum his only advice to me was to look after the interests of some of these workers.

Dr. Stratton also was anxious that the staff members should continue their personal advancement. Thus he was instrumental in establishing within the bureau an almost complete educational system. Many a doctor's dissertation has been worked out at the bureau and accepted at leading universities. As a recruiting ground for workers in industrial research, it is doubtful if any university surpassed it. The director was ardent in his desire to have the science at the bureau serve the industries of the country. He devised a system of industrial research fellowships to augment this service and to keep the well from going dry.

It is generally known that the Bureau of Standards started long after similar institutions in Europe and that in the twenty-two years it became recognized as a leading institution. The bureau is truly a monument to Dr. Stratton, although I never saw him more perturbed than the time a member of the House openly accused him of spending public money to erect a monument to himself.

Dr. Stratton found it very difficult to leave the bureau to accept the presidency of the Massachusetts Institute of Technology. Because of the industrial situation at the time, all New England joined in the call of the institute and it was thus irresistible. His good work there, eight years as president and finally chairman of the corporation, is well known. It was most fitting that a memorial meeting was held at the bureau simultaneously with the services at the institute.

His friends were planning a national dinner to honor his seventieth birthday, but his spokesman gave assurance that this could not be acceptable. Dr. Stratton was not a master publicity man of the kind known to high-pressure salesmen, but immortality has come to him because of his work and by the many touches from his warm and wise personality. His influence on science and industry in this country has been so great and so ramified that any superlative would be inadequate. His recognitions were many. He received the degree of doctor of science from the University of Pittsburgh in 1903; the same degree from Cambridge University (England) in 1909; the LL.D. from Harvard in 1923 and later from Yale; and the Ph.D. from Rensselaer Institute in 1924. He was a member of Tau Beta Pi, Sigma Xi and Phi Beta Kappa. For years he was an officer in the Naval Reserve, and he was in active service during the Spanish War. He was a commander of the Legion of Honor. The Elliott Cresson Medal of the Franklin Institute was bestowed upon him. His membership included the National Academy of Sciences, the National Research Council, the American Physical Society, the Optical Society of America, the Franklin Institute, the Philosophical Society of Washington, the Washington Academy of Sciences, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the International Committee of Weights and Measures. Among his club memberships may be listed the Cosmos, Chevy Chase and Army and Navy, of Washington, D. C., the Algonquin, Union, Tavern, Engineers, and University, of Boston, and Union Inter-Allee of Paris.

His duties in organizations, as president, as chairman, trustee, committeeman, or member of board, were too numerous to describe here. These generally carried a public duty, in science, industry, government, in a society, a public institution or even in a judiciary group. He gave to these himself wherever possible. On occasion it was necessary for me to substitute and report to him in such groups as the National Advisory Committee for Aeronautics, the Ice Patrol Board, the Industrial Conference Board, the National Screw Thread Commission, the President's Interdepartmental Patents Committee and the like. Sometimes he would hold similar responsibilities because of his sense of personal obligation. I know he continued to attend the trustees' meetings of the New York Museum of Science and Industry because he could help me. He

seemed to regard a personal obligation as a privilege, and he was rarely conscious that he had more than done his part.

F. C. BROWN

RECENT DEATHS

DR. JOHN WHITRIDGE WILLIAMS, professor of obstetrics at the Johns Hopkins University Medical School since 1893 and dean of the school from 1910 to 1923, died on October 22, at the age of sixty-five years.

DR. JOSEPH MERRITT MATTHEWS, authority on textile chemistry and dyestuffs, died in San Diego, California, on October 12, aged fifty-seven years. For some years Dr. Matthews was professor of chemistry and dyeing in the Philadelphia Textile School.

MR. HENRY LORENZ VIERECK, an authority on the Hymenoptera, was killed in an automobile accident at Loudonville, Ohio, on October 9. Dr. Viereck was fifty years old.

COLONEL JOHN S. A. JOHNSON, professor of applied mechanics and experimental engineering and director of the experiment station at the Virginia Polytechnic Institute, was recently found shot to death in his bedroom at his home on the campus. He was fifty-three years old and had been professor at the institute since 1900.

SCIENTIFIC EVENTS

THE NEW FEDERAL CITRUS FRUIT LABORATORY IN TEXAS

DR. HENRY G. KNIGHT, chief of the bureau of chemistry and soils of the U. S. Department of Agriculture, recently announced that a new citrus laboratory of the bureau, for which funds were appropriated by the last Congress, will be established in the citrus-growing territory of the Rio Grande Valley at Weslaco, Texas, on the state-owned land of the Texas State Experiment Station for the study of citrus fruit culls and their by-products.

The selection of a site on the agricultural experiment station grounds at Weslaco was made upon recommendation of Dr. F. C. Blanck, in charge of the food research division of the bureau of chemistry and soils, and Mr. E. M. Chace, of the bureau's fruit and vegetable laboratory at Los Angeles, California, with the approval of Director A. B. Conner, of the Texas Agricultural Experiment Station.

The chambers of commerce of Weslaco and Mercedes, Texas, have agreed to erect a suitable building for the citrus work of the bureau. In recommending this site for the bureau's by-product work with citrus fruits, the department specialists said: "We feel that the selection of Weslaco is absolutely logical and that it offers special advantages, because of the effective cooperation with the state experiment station which it makes possible and because our work at Weslaco will be located in the center of the citrus-growing territory of Texas."

Director Conner, of the Texas Agricultural Experiment Station, in commenting on the establishment of the federal work in the utilization of citrus by-products, says: "The location of this proposed laboratory at the substation ought to be mutually advantageous to agencies working in behalf of the citrus industry. With the concentration of both federal and state activities at this one station, it will receive increased recognition as a center of research for the Texas citrus-producing industry."

Dr. Knight states that work will begin on problems of citrus-fruit utilization at the bureau's new laboratory as soon as the buildings are completed and the equipment is installed, and that the first year's work will center largely upon problems of grapefruit utilization. The laboratory, he says, will study the composition of different varieties of Texas grapefruit to learn what stage of maturity is most favorable for preservation. Other studies will center upon utilization of waste from canneries and juice factories, and the feasibility of preparing grapefruit oil, pectin, naringin and other valuable constituents from oil and waste material.

The assistance which similar laboratories of the Department of Agriculture have rendered citrus-fruit growers of California and Florida in solving problems of by-product disposal has led to the extension of this work to Texas, fruit growers of that state having made repeated requests for such aid. Total plantings of citrus in Texas amount to approximately 6,650,000 trees, of which about one half are in bearing. This represents an acreage of about 90,000, with grapefruit accounting for three fourths of the total.

PSYCHIATRIC EDUCATION

IN order to meet the growing demand for trained workers in psychiatry and mental hygiene the National Committee for Mental Hygiene has created a new division of psychiatric education, Dr. C. M. Hincks, director of the committee, has announced in a statement sent out by Science Service.

"The dearth of competent psychiatrists is becoming a major issue in human welfare," a committee of the American Psychiatric Association, which has been studying the problem, has concluded.

"It is no longer merely a matter of overcrowded mental hospitals in which the patients receive but momentary attention from the mental specialists. We are confronted by a matter amounting to a national emergency," their report stated.

Of the 160,000 physicians in the United States today, somewhat over 40,000 are specialists in the various branches of medicine. Of these only 1,600 are psychiatrists, or one in twenty-five. In other words, there are a hundred times as many doctors in physical as in mental medicine, the committee pointed out. This is out of all proportion to the magnitude of the problem of nervous and mental disease. Half of the hospital beds of the country are occupied by patients suffering from mental disease, and there are many more not in hospitals.

The new division of psychiatric education will center its work largely around the medical schools, with a view to attracting more medical students to this branch of medicine and to giving those who plan to engage in other specialties or in general medicine instruction which will better equip them for dealing with such problems of mental health as will inevitably arise in their work.

The director of the division will be Dr. Ralph A. Noble, of Sydney, Australia, and associated with him will be Dr. Franklin G. Ebaugh, director of the Colorado State Psychopathic Hospital.

THE NINTH INTERNATIONAL CONGRESS OF PURE AND APPLIED CHEMISTRY

THE Ninth International Congress of Pure and Applied Chemistry is to be held under the patronage of the Government of the Spanish Republic in Madrid, from April 3 to April 10, 1932. It will be twenty years since such an international congress has been held, the eighth having met in Washington and New York in 1912.

According to a statement in *Industrial and Engineering Chemistry*, the National Council of the Spanish Federation of Chemical Societies, upon which the Spanish Society of Chemistry and Physics, the Society of Spanish Mining Engineers, the National Union of Chemical Experts, the Academy of Sciences, the Institute of Oceanography and the National Chamber of Chemical Industries are represented, is the body which is affiliated with the International Union and which has the responsibility for the details of the congress. The honorary president is J. R. Mourelo, vice-president of the Academy of Sciences and professor emeritus of the School of Arts, University of Madrid; the president, O. Fernández, professor of the University of Madrid, member of the Academy of Sciences, and dean of the Academy of Pharmacy; the general secretary, E. Moles, professor of the University of Madrid, and of the National Institute of Chemistry and Physics, as well as president of the Spanish Society of Chemistry and Physics.

The rules which will govern the congress are in part as follows:

I. The object of the Ninth International Congress of Pure and Applied Chemistry is to further the progress of pure chemistry and all its applications, as well as to strengthen relations between chemists the world over.

II. Any person professing interest in any one or more of the objects of the congress may enroll as a member.

III. The membership of the Ninth International Congress of Chemistry shall be divided into three categories, *viz.:*

(*a*) *Honorary Members:* All members of the Committee of Honor and of Patronage, the official delegates of the Spanish government and of the governments of other countries.

(*b*) *Supporting Members:* All persons who individually (whether payment be made in joint accounts or in any other manner) pay the minimum amount of 250 gold pesetas.

(*c*) *Active Members:* All who pay the general fee of 50 gold pesetas. The application for membership shall vouch for the applicant's agreement to all the rules and regulations of the congress. All members shall be entitled to receive all publications *in extenso*, to take part in the sessions of the congress and to receive copies of the daily newspaper which will be published, as well as a separate issue of all the summaries of the communications and documents referring to the congress, including the final report on the proceedings. Members shall also be entitled to attend the receptions and festivities in connection with the congress, unless otherwise indicated on the program, which will accompany the identification cards.

IV. Tickets at 15 gold pesetas each will be issued for ladies wishing to accompany the members of the congress. They will be granted the same privileges as members except that they will not be allowed to take active part in the sessions, or receive publications.

V. The congress will be divided into the following groups, each of which will have a section on pure, and one on applied, chemistry; Group 1, physical and theoretical chemistry; Group 2, inorganic chemistry; Group 3, organic chemistry; Group 4, analytical chemistry; Group 5, biological chemistry; Group 6, teaching and economics. The executive committee is authorized to increase the number of sections as the need of the congress may demand.

THE HENRY BURCHARD FINE HALL OF MATHEMATICS

THE Henry Burchard Fine Hall of Mathematics was dedicated at Princeton University on October 22.

The hall has been erected at a cost of $500,000 in memory of the late Professor Fine, who organized the

department of mathematics at Princeton University and was for twenty years dean of the department of science. The money for the erection and an endowment of $150,000 for its upkeep were given shortly after Dean Fine's death in 1928 by the late Thomas D. Jones and his niece, Miss Gwethalyn Jones, of Chicago.

The new structure is in the southeastern portion of the campus, adjoining and connected with the Palmer Physical Laboratory. It is built of red brick and limestone and was designed by Charles Z. Klauder, of Philadelphia, in collegiate Gothic style to conform with neighboring campus buildings. Overstuffed chairs and davenports take the place of chairs and desks and the classrooms are fitted out after the manner of private studies.

Mathematical formulae have been used as decorative motifs of the building. Designs on some of the windows include the Newtonian equation of gravitation, formulae of Einstein, two equations on the quantum theory, the five perfect solids and spheres and the three conic sections. Over the fireplace in the common room is engraved a German quotation from Einstein.

Preceding the dedication, Professor Gilbert A. Bliss, of the University of Chicago, and Professor George D. Birkhoff, of Harvard University, read papers in one of the lecture rooms. Both are former teachers at Princeton University.

SCIENTIFIC NOTES AND NEWS

THE corner-stone of the New York State Theodore Roosevelt Memorial at the American Museum of Natural History was laid by Governor Franklin D. Roosevelt on October 27.

THE Baly Medal of the Royal College of Physicians, which was awarded to Dr. Walter Bradford Cannon, professor of physiology in the Harvard Medical School, will be presented to him in November, as announced by Lord Dawson of Penn at the annual Harveian commemoration of the college on October 18. The Harveian oration was delivered by Dr. Robert Hutchison on "Harvey, the Man and His Methods: A Message for Us To-day."

IN recognition of his research work in dental nutrition, Dr. Percy R. Howe, professor of dental science in Harvard Medical School, director of the Forsyth Dental Infirmary and past president of the American Dental Association, has been awarded the 1931 Fauchard medal presented by *Dental Survey*.

AT the forty-second annual meeting of the German Pediatric Society, Dr. Alfred F. Hess, of New York, and Dr. Henry J. Gerstenberger, of Cleveland, were elected to honorary membership.

A DINNER in honor of Dr. Charles Wardell Stiles will be given at the Cosmos Club, Washington, on November 7. Dr. Stiles retired from active duty in the U. S. Public Health Service on October 1, after more than forty years of service in the government.

THE first Joseph Henry Lecture under the auspices of the Philosophical Society of Washington was given at the Cosmos Club, Washington, by President Joseph S. Ames, of the Johns Hopkins University, on October 24. His subject was "Certain Aspects of Henry's Experiments on Electro-Magnetic Induction."

DR. WILLIAM H. WELCH, professor emeritus of the history of medicine at the Johns Hopkins Medical School, spoke on October 23 at the first of an annual series of "Field Nights" to be held by the University Club, of which he is president. Dr. Welch, who recently returned from abroad, spoke on European medical and scientific congresses and celebrations, at several of which he was the principal speaker and guest of honor.

DR. T. M. BRODERICK, for the past eleven years chief geologist of the Calumet and Hecla Mining Company and previously assistant professor of geology at the University of Minnesota, has been appointed research professor of geology at the Michigan College of Mining and Technology. He retains his connection with the mining company; at the college he will devote most of his attention to investigating the utilization of low-grade iron ores. Further appointments are: Dr. Irwin Roman, formerly on the staff of Vanderbilt University and later mathematical physicist with the Geophysical Research Corporation, as assistant professor of mathematics and physics; Dr. F. A. Rohrman, of Columbia University, as assistant professor of chemical engineering; E. W. Schilling, of Iowa State College, as assistant professor of electrical engineering; H. W. Risteen, of the University of Wisconsin, as assistant professor of mechanical engineering; Dr. L. W. Eastwood, E. J. Townsend, T. R. Maki, William Gertz and Lloyd Staples, as instructors in various technical departments.

DR. JAMES A. CRABTREE, director of the division of preventable diseases in the Tennessee state department of health, has been appointed assistant professor of epidemiology at the Johns Hopkins University School of Medicine.

MISS E. KATHARINE WRIGHT, formerly associate

professor of chemistry at North Carolina College, Greensboro, N. C., is now professor of chemistry at Constantinople Woman's College.

DR. ARTHUR J. MIX, professor of botany at the University of Kansas, has been made head of the department.

DR. J. H. HOSKINS, associate professor of botany at the University of Cincinnati, has been made chairman of the department of botany.

MR. JOHN T. SANFORD, curator of geology and paleontology of the Buffalo Museum of Science, has become instructor in geology at the University of Rochester.

MR. R. W. SANDELIN has been appointed instructor in the chemistry department, Georgia School of Technology, Atlanta, Georgia.

THE Medical Fellowship Board of the National Research Council, of which Dr. G. Carl Huber is chairman, has made the following appointments of fellows in medicine for the year 1931–32: Louis B. Laplace, Paul E. Steiner, Phillips Thygeson and Cecil J. Watson. The spring meeting of the board will be held in the latter part of March, 1932, and applications to be considered at that time should be filed on or before February 15.

W. RUDYERD BOULTON, formerly a member of the staff of the Carnegie Museum of Pittsburgh, has been appointed assistant curator of birds in the department of zoology at the Field Museum of Natural History.

DR. STANLEY HARCOURT PEPPARD, formerly of New York, has been appointed director of the bureau of mental hygiene of the state department of health of Connecticut. He succeeds Dr. James L. McCartney.

MR. R. F. MEHL, superintendent of the division of physical metallurgy of the Naval Research Laboratory in Washington, has been appointed assistant director of research and head of the physical science department of the American Rolling Mill Company, of Middletown, Ohio.

ROGER W. TRUESDAIL, formerly assistant professor of chemistry in Pomona and Claremont Colleges, has resigned and established a consulting and research practice in biological and nutritional chemistry in Los Angeles.

ENGINEER CAPTAIN J. B. PULLIBLANK has been appointed a naval aide-de-camp to the King of England, from September 8, in succession to Engineer Captain R. Beeman, who has been promoted to engineer rear-admiral.

HAVING reached the statutory age for retirement, Mr. H. A. Hunt has retired from the position of meteorologist to the Commonwealth of Australia. Mr. W. S. Watt has been appointed his successor.

DR. LERICHE, professor of clinical surgery at Strasbourg University, has been appointed professor of external pathology of the medical faculty of the University of Lyons.

MR. BEN P. BOLE, JR., Cleveland, Ohio, has returned from the Olympic Peninsula of Washington with more than 600 specimens of small North American mammals and a 550-pound bear for the American Museum of Natural History. He was accompanied by Mr. Frank C. Hibben, of the museum staff.

PROFESSOR BERNHARD NOCHT, formerly director of the Tropical Institute at Hamburg, has gone to Brazil to study leprosy, at the request of the League of Nations.

DR. HILMAR ØDUM, of the Geological Survey of Denmark, Copenhagen, has been in Washington studying Eocene and Upper Cretaceous fossils at the National Museum and the organization and methods of the ground water division of the Geological Survey.

DR. J. F. VAN BEMMELEN, professor emeritus in zoology at the University of Groningen, Holland, arrived in New York on October 20. He will give a series of lectures in Boston.

DR. C. B. BRIDGES, of the Carnegie Institution of Washington, working at the California Institute of Technology, gave an address on "Genic Balance and Related Problems" at a meeting of the Genetical Society, London.

DR. ALFRED V. KIDDER gave a lecture at the Carnegie Institution of Washington on October 27 on "The Survey of Yucatan; a Cooperative Study of the Maya Indians, Ancient and Modern."

DR. ARNOLD GESELL, of Yale University, has delivered a lecture on "The Psychology of Growth," illustrated with motion pictures, at the New School for Social Research. Dr. Joseph Jastrow introduced the speaker.

ON October 15 and 16, three lectures were delivered at the University of Michigan by Professor R. Woltereck, of the University of Leipzig. The titles were as follows: "Genetics and the Biology of Lakes and Islands"; "Present State of the Marine and Freshwater Biology in Europe"; "Stratification, Movement and the Shape of Pelagic Cladocera."

THE following illustrated popular lectures on astronomy are being given at Los Angeles, under the auspices of the Astronomical Society of the Pacific and the Mount Wilson Observatory of the Carnegie Institution of Washington: November 20, "What

Happens in Sun Spots?" Dr. Henry Norris Russell, of Princeton University; December 18, "The System of the Stars," Dr. Joel Stebbins, of the University of Wisconsin; January 6, "The Size of the Universe," Dr. Willem de Sitter, of the University of Leyden; February 19, "The Stars about Us," Dr. Frederick H. Seares, of the Mount Wilson Observatory; March 18, "What Astronomy has Done for the World," Dr. Russell Tracy Crawford, of the University of California; April 15, "Mars," Dr. Mars F. Baumgardt, of the Southern California Academy of Sciences.

THE recently formed section of hydrology of the American Geophysical Union announces the organization of a committee on the hydrology of glaciers, composed of the following men: Dr. Stephen R. Capps, senior geologist, Alaska branch, U. S. Geological Survey; Dr. Harry Fielding Reid, professor emeritus of dynamic geology, Johns Hopkins University; G. L. Parker, district engineer, water resources branch, U. S. Geological Survey; Carl P. Richards, chairman of the research committee of the Mazamas, Portland, Oregon; R. H. Sargent, senior topographic engineer, Alaska branch, U. S. Geological Survey; Dr. Wallace R. Atwood, assistant, branch of research and education, National Park Service; François E. Matthes, senior geologist, section of glacial geology, U. S. Geological Survey, chairman. The functions of the committee correspond in general to those of the Glacier Commission appointed by the section of scientific hydrology of the International Geodetic and Geophysical Union in Europe and will consist principally in securing systematic records of the annual variations of American glaciers.

THE Botanical Society of New Orleans held its first meeting of the season of 1931–32 on October 20. Dr. Robert Glenk, curator of the Louisiana State Museum, presented a paper on "Some Facts about Perfume-yielding Plants," illustrating his discussion with slides and with a selected set of specimens of the raw materials representing the basic perfume types. The ensuing business meeting dealt principally with the program for the coming year and with plans for the coming New Orleans meeting of the American Association for the Advancement of Science.

THE will of the late Senator Dwight Whitney Morrow contains the following provisions: (e) To the trustees of Amherst College, a body corporate established by law in the Commonwealth of Massachusetts, two hundred thousand dollars ($200,000). Without limiting such trustees' discretion in their use of this absolute bequest, I here mention my preference that this bequest be added to the general endowment of the college, the income to be applied to the maintenance and, if possible, to the increase of professors' salaries at such college; (f) To the trustees of Smith College, a corporation established by law in the Commonwealth of Massachusetts, two hundred thousand dollars ($200,000), to be part of the endowment funds of such college; (g) To the Smithsonian Institution, city of Washington, D. C., one hundred thousand dollars ($100,000), to be part of its endowment funds; (h) To the trustees of Columbia University in the city of New York, fifty thousand dollars ($50,000), to constitute a fund, the income of which is to be applied, from time to time, to the uses and purposes of its School of Law; (i) To the Union Theological Seminary in the city of New York, fifty thousand dollars ($50,000), to be part of its endowment funds.

SEVEN members of the privately financed exploration and filming expedition to Colombia and Ecuador, known as the Latin-American Expedition, Inc., sailed on September 26 for Panama on the Grace liner *Santa Maria,* for seven months' intensive research, with Dr. Matthew W. Stirling, of the Smithsonian Institution, as chief of the scientific division. Dr. Stirling is to conduct an investigation at the headwaters of the Magdalena River of the ancient monoliths, which he believes may furnish a clue to the riddle of the migration of the early peoples in the Western Hemisphere. It is also planned to explore the Napo River in Ecuador and to study the habits of the Jivarro Indians, who are known as head hunters.

DISCUSSION

COURSES ON THE HISTORY OF PHYSICS IN AMERICAN COLLEGES AND UNIVERSITIES[1]

IN 1921 a survey was made of the instruction being given in the history of the sciences in American colleges and universities.[2] Information was gathered by means of questionnaires that had been sent to about four hundred institutions and it was found that there was considerable interest in the historical development of the various branches of science. There were numerous replies expressing the hope that there would be a further expansion of this field of study.

[1] Read before the Ohio Academy of Science, April 4, 1931.

[2] E. H. Johnson, "The Present Status of the History of Science in American Colleges and Universities." SCIENCE, n.s., LVI: pp. 585–595, December 16, 1921.

During the decade that now has elapsed, college curricula in general have undergone great changes, and there have appeared many publications dealing directly with the history of science. Hence it has seemed desirable to make a new survey. The present report—dealing only with instruction in the history of physics—is but a part of the yet unfinished study which is to include all of the various branches of science now being taught in American colleges.

This new investigation has been carried out along lines wholly different from those followed in the study of 1921. Only the regular college publications such as catalogues, special bulletins and course lists have been consulted. It was felt that this procedure, while imperfect, would eliminate many of the defects inherent in the questionnaire method.

To date the curricula of 320 of the colleges and universities in the United States have been examined. This number includes the majority of the stronger institutions regardless of the nature of their support, whether state, denominational, non-sectarian or private, also coeducational institutions and those for men or women only. They have a wide geographic distribution. Of this number, 51 are now offering courses on the history of physics as regular, credited units in the curriculum, and there is no indication that in any of these institutions this type of course is being given as anything but a serious and worthwhile study. A little more than half of these 51 institutions are east of the Mississippi River, while 70 per cent. are north of the latitude of that imaginary dividing line associated with the names of Mason and Dixon. Of the southern group, 30 per cent. are in California. In other words, the northern states and California offer four-fifths of the courses on the history of physics now available in the United States. Naturally, coeducational institutions predominate, making 72.5 per cent. of the total, while men's and women's colleges amount to 7.9 and 19.6 per cent., respectively.

Of the 51 institutions considered here, 39 are offering courses strictly limited to the history of physics, while the other 12 give a small part of the time to allied subjects or pedagogic procedures. 13 of the purely physics courses deal with selected, special topics, such as the development and influence of outstanding theories, *e.g.*, the wave theory of light or the rise of the 19th century ideas of the conservation of matter and energy. While the majority of courses include surveys of the growth of physical science from the earliest times, there are a few that deal with the developments of the past twenty-five or fifty years only, taking them up in such a connected, chronological order as to warrant classification as historical.

The forms of instruction differ widely. Probably few teachers of physics have learned much about the origins of their science until after they have passed through their own college training period. Only after becoming specialists have they found time to look back over the field they have entered. Consequently each will develop his own best method of approach in teaching the history of physics. It is not an easy subject to handle adequately, but the task has been lightened somewhat by the appearance during the past few years of several special textbooks, and the number of classic papers available has been increased by numerous reprints and the publication of photographic copies of the originals. In nearly all of the courses examined, the lecture method is prominent. Next come the use of a textbook, and in order of frequency, assigned reading of outside sources and class reports with discussions. In several intitutions classical experiments are repeated as class demonstrations, and in at least one university the students themselves are required to prepare and deliver part of the lectures.

The question of prerequisite subjects is of importance. In a few institutions no requirements are made, but in the majority of cases, one or even two years of college physics are required for admission to classes in the history of physics. Some of the better schools even go further than this, and admit only seniors or graduate students in physics.

It has not been possible to determine the mathematical prerequisites definitely, but a number of colleges do require the calculus. Of course this requirement would be met automatically by all students qualifying where advanced physics courses are demanded.

In practically every case the history of physics is given on the same basis as any other advanced physics elective, *i.e.*, during one or two semesters and receiving from two to four credits towards graduation.

Probably all physics teachers introduce many topics in their regular lecture discussion in their historic sequence. Some of the more recent college physics texts emphasize this historic form of presentation of subject-matter, because their authors feel that it has great appeal and cultural value for the general student, while it supplies a highly desirable background for the specialist.

Reference was made above to the indications of a growing interest in the history of science. German scholars have appreciated the value of this field of study for many years. Only recently has there been any very serious attention given to it in America. But now it is growing and attracting notice abroad. Recently I received a letter from a lecturer at the University of London asking about the general procedure in this country. It showed two things very

clearly: first, that English scholars have a genuine appreciation of the value of the study of the history of the physical sciences, and, second, a recognition of American activity in this same field. Present indications are that the study of this phase of the growth of civilization soon will win an important place in the curriculum of the American college.

E. H. JOHNSON

KENYON COLLEGE

A NEW ELM DISEASE

AFTER the identification of the Dutch elm disease in Ohio, during the summer of 1930, some 300 specimens of diseased elm trees were collected or received from correspondents, examined and the fungi in them isolated in cultures at the Dutch elm disease laboratory operated by the Ohio Agricultural Experiment Station and the division of forest pathology, Bureau of Plant Industry, at Wooster, Ohio. In these cultures it was found that a certain fungus was present in a little over ten per cent. of the cases. The past history and the condition at that time of several of the trees from which this fungus was isolated indicated that they were probably parasitized, some dying entirely during the summer of 1930 and others losing part of their tops. On the strength of these observations, soon after growth began this spring, fourteen young elms were inoculated with the fungus.

About a month after inoculation, symptoms of disease appeared on seven trees. Drooping and wilting of the leaves, preceded or accompanied in most cases by a distinct yellowing was first noted. In a short time most of the leaves dropped although some leaves turned brown and remained on the twigs for more than a month. The diseased twigs and branches died as well as the main trunk above the point of inoculation. A blackening of the bark, which in a few cases extended directly up the trunk from the point of inoculation, was noted on some trees. Apparently the disease made more rapid progress upward than downward, since the branches below the point of inoculation with a few exceptions remained healthy. The entire top of one tree, inoculated at the base, died.

A brown discoloration of the cambium and current growth of sapwood was evident when cross-sections of the diseased branches were examined. The staining in the inoculated trees was more uniform and somewhat more diffused than that found in trees affected with either the Dutch elm disease or Verticillium wilt. However, the discoloration in some cases resembled that of the two latter diseases markedly.

The fungus was reisolated from the inoculated diseased trees but not from inoculated trees which did not develop the disease, although attempts were made to do so. Check trees remained healthy.

On potato dextrose agar the fungus first appears from plantings of diseased wood as a white, cottony colony of aerial mycelium. Later it becomes light brown. But one type of spore has been noted in the cultures. They are hyaline, generally elliptic, although the shape is variable, and in most cases contain one or two oil drops. The average size of 50 spores was 1.9 x 4.5 microns. Occasionally a group of spores loosely bound together in a small head and borne on the end of a short conidiophore was found. For this reason the fungus is tentatively referred to Cephalosporium. No difficulty is experienced in distinguishing this fungus from *Graphium ulmi* Schwarz. Although the spores are about the same size, the type of growth of the colony, its color, and the relatively scant spore production differentiate it from the organism causing the Dutch elm disease.

The fungus was cultured from specimens sent to the Dutch Elm Laboratory from Iowa, Missouri, New York and Washington, D. C., as well as from various localities in Ohio. A more detailed study of the disease and the fungus is in progress.

CURTIS MAY

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THE GALL BLADDERS OF CHICKS IN A VITAMIN D DEFICIENT CONDITION[1]

SEVERAL times during the past few years we have noted in this laboratory that the gall bladders of chicks in a vitamin D deficient condition appeared to be larger than those of chicks of the same age but receiving an adequate supply of this vitamin.

Recently there was an opportunity to make quantitative observations of the gall bladders of two groups of chicks which had been on an experiment from hatching until nine weeks of age. Both groups received the same basal ration, which was deficient in vitamin D. For Group 1, 1 per cent. of cod-liver oil was incorporated in the ration, but Group 2 subsisted on the basal ration only. When the chicks were killed at nine weeks of age leg weakness was quite marked in the latter group, whereas the former was normal. The average weight of the gall bladders of Group 1 (ample vitamin D) was 0.57 gm (P.E. $\pm$ 0.04) and that of those of Group 2, 1.27 gm (P.E. $\pm$ 0.12). When the probable error of the difference between the two means is calculated and compared with the difference, a high degree of significance is obtained. Although accurate measurement of the volume of bile from the two sets of bladders was not feasible, the volume in the case of the deficient chicks was markedly larger than that of the normal chicks. It is significant that although the average

[1] Journal Series paper of the New Jersey Agricultural Experiment Station.

body weight of the vitamin D deficient group is approximately 60 per cent. of that of the normal group, the average weight of the gall bladders of the former is slightly more than twice that of the latter.

Whether the enlarged gall bladder is characteristic of the vitamin D deficient condition or whether it is found in chicks deprived of other dietary factors is not known.

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A TREMATODE FROM THE CLOACA OF THE GULL

RECENT experiments at the Marine Biological Laboratory, Woods Hole, Massachusetts, have shown that the oyster drill, *Urosalpinx cinereus,* is the snail host of *Parorchis avitus* (Linton 1914),[1] the adult trematode having been originally described from the herring gull, *Larus argentatus.* The cercaria was found by Stunkard in the summer of 1930 and a complete description of it has been submitted for publication. On account of the resemblance of this larva to *Cercaria purpurae*[2] which has been reported by Lebour and Elmhirst[3] to be the cercaria of *Parorchis acanthus* (Nicoll),[4] it was suggested that the present species might be the cercaria of *Parorchis avitus.*

Most of the larvae encyst on the bottom of the dish within forty-eight hours after escaping from the snail. They have not been found to encyst in the mantle of *Mytilus edulis,* as reported by Lebour and Elmhirst for the cercariae of *Parorchis acanthus.* This gives another specific difference between *Parorchis avitus* and *Parorchis acanthus.* The cysts were fed to tern nestlings which were brought into the laboratory shortly after hatching. Twelve flukes were obtained from the cloaca of a single bird which was killed ten days after the infestation was established. Although the worms recovered were not sexually mature, they were readily identified as *Parorchis avitus,* and this identification has been confirmed by Dr. Edwin Linton. Experiments are now being made in order to obtain mature worms and to complete the life history by infesting the snail. A detailed account of this work will appear at a later date.

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HYBRID WORDS

"SHAPOMETER" is a good expressive word, and Messrs. Tester and Bell are to be commended for disregarding pedantic conventions to secure a good word that suits their purpose. If such words are "obvious hybrids, interdicted by good usage," as stated by Mr. Dayton in the issue of June 26 (73: 704), it is time for scientists, who live in the present and face the future, to change the usage. Our language contains far too many words like "morphometer" or "psephometer" formed with undue consideration of a dead language and too little consideration of the needs of a living language and a progressive people. The English language would be in better shape if some people knew less Greek and Latin.

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REPORTS

GRAVITATIONAL AND ELECTROMAGNETIC FIELDS

PROFESSOR ALBERT EINSTEIN has recently completed a part of his work (in collaboration with Dr. Walter Mayer) on the "Unitary Theory of Gravitation and Electricity." It will be published in the near future probably in Pasadena in connection with Professor Einstein's investigations of last winter. Meanwhile Professor Einstein has prepared a preliminary announcement for the Josiah Macy, Jr., Foundation, under a grant from which the work was done. The statement was prepared by Professor Einstein in German, and the publication in English has been authorized by him. It reads:

Ever since the formulation of the general relativity theory in 1915, it has been the persistent effort of theoreticians to reduce the laws of the gravitational and electromagnetic fields to a single basis. It could not be believed that these fields correspond to two spatial structures which have no conceptual relation to each other. Thus arose the theories of Weyl and Eddington, which, however, have been abandoned by their authors, the theory of Kaluza and also the theory of distant parallelism. After we both had worked more than a year on the further development of the last theory, we reached the conclusion that we were striving in the wrong direction and that the theory of Kaluza, while not acceptable, was nevertheless nearer the truth than the other theoretical approaches.

Kaluza's theory rests on the assumption that the

[1] *Proc. U. S. Nat. Mus.,* 46: 551–555, 1914.
[2] *Trans. Nat. Hist. Soc.,* Newcastle, n. s., 1: 437–454, 1907.
[3] *Jour. Mar. Biol. Ass'n,* Plymouth, n. s., 12: 829–832, 1922.
[4] *Quart. Jour. Mic. Sci.,* 51: 345–355, 1907.

physical space-time continuum is five dimensional (instead of, as formerly, four dimensional) in which the empiric four-dimensionality of the physical continuum can be accounted for by the hypothesis that the physical variables are independent of the coordinate $\times 5$. By postulating a Riemann metric in five dimensions, Kaluza reaches field laws which agree in first approximation with the known field laws of gravitation and electricity.

Among the considerations which question this theory stands in the first place: It is anomalous to replace the four-dimensional continuum by a five-dimensional one and then subsequently to tie up artificially one of these five dimensions in order to account for the fact that it does not manifest itself.

We have succeeded in formulating a theory which formally approximates Kaluza's theory without being exposed to the objection just stated. This is accomplished by the introduction of an entirely new mathematical concept which may be described as follows:

Until now it has been believed that one can introduce into a space of n dimensions only vectors or vector-fields of which the number of components agrees with the number of dimensions of that space. It appears, however, that this restriction is not necessary. It has its origin in the "anschauliche" significance of those vectors responsible for the formulation of the vector concept. We have been successful in introducing into space R_n of n dimensions, vectors $a^i (i = 1 \ldots m)$ of m components and in deriving a calculus of such vectors and tensors which is essentially no more complicated than the well-known absolute calculus.

Our theory arises quite readily from consideration of five-vectors (five components) in the four-dimensional continuum. There follows from that a "five-curvature" of space which is analogous to the Riemannian curvature, and which bears a similar relationship to the laws of the unitary field that the Riemannian curvature does to the relativistic equations of the gravitational field alone.

This theory does not yet contain the conclusions of the quantum theory. It furnishes, however, clues to a natural development, from which we may anticipate further results in this direction. In any event, the results thus far obtained represent a definitive advance in knowledge of the structure of physical space.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

PROTECTIVE COATINGS FOR MINERAL AND ROCK SPECIMENS[1]

A LARGE number of density determinations are made in this laboratory on rock specimens, many of which are very porous and some quite friable. The method used was described by Gealy[2] and consists of measuring the volume of the specimen by noting the displacement of mercury in a Russell tube, the weight of the mass and the volume of the grains. In 1920, Melcher[3] described a method for determining pore space of oil and gas sands in which he coated the specimens with paraffin to prevent loss of material and penetration of the immersion liquid. The amount and volume and density of this paraffin had to be determined and account taken of these factors in computing the pore space of the sand. Furthermore, great care had to be exercised in the application of the paraffin to keep it from penetrating too deeply into the specimen and to prevent or eliminate air bubbles in the paraffin itself which would vitiate volume measurements. Gealy substituted mercury for acetylene tetrachloride in the Russell apparatus in order to eliminate the use of paraffin. However, it was found that even mercury has a tendency to penetrate the very large pores of a rock and often erroneous volume measurements were obtained.

This difficulty has now been overcome by the use of a new protective coating consisting of a solution of ordinary photographic film in butyl acetate. The emulsion is thoroughly cleaned off of used film by digestion in hydrochloric acid. Just enough butyl acetate is used to cover the film and it is set aside in a closed vessel to dissolve. Solution takes place quite slowly. It is necessary to filter, using a suction filter, to obtain a product that is free from strings. When applying the coating of film scrap to a specimen it may be diluted with acetone if necessary. The solvent evaporates very rapidly and seems to leave a plug of film in the outer pores that effectually prevents penetration of a non-solvent liquid. No readily discernible coating is left on the specimen. By trial it has been shown that the volume of the coating can be ignored for all practical purposes since it affects the percentage pore space volume only in the third decimal place.

Another very important and possibly extensive use for film scrap solution, once it is known to scientific men, is in the preservation of museum specimens. A specimen of sandstone that was so friable it could not be touched without considerable loss of material was covered with film scrap applied with a camel's hair brush. In a few moments it was dry and in appearance the coated specimen could not be distinguished from an uncoated one. However, it can now

[1] Published by permission of The Gulf Companies.
[2] W. B. Gealy, Bull Amer. Assoc. Pet. Geol., Vol. XIII, 1929, Part 1, p. 677.
[3] A. A. Melcher, Trans. Amer. Inst. Min. Met. Eng., Vol. LXV, p. 469.

be handled with moderate care and no sand grains are knocked off in the handling. Likewise very fissile shale specimens have been preserved *en masse* for laboratory hand specimens.

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A SHORT METHOD FOR THE PREPARATION OF ANIMAL TISSUES FOR STAINING

CUT the tissue in pieces from two to four millimeters in thickness. Drop these in some ten per cent. formalin solution and heat to boiling. Transfer them to acetone for dehydration and leave them in this liquid for one hour, during which time the acetone should be poured off and renewed with fresh material two or three times. The dish should be covered and put in the paraffine oven, as diffusion takes place more rapidly at the higher temperature. Remove the tissue from the acetone and drop it into a container of melted paraffine. Leave this in the oven for one hour.

Embed, mount on block and cut in the usual manner. Smear the slides lightly with Mayer's albumen, float the sections over this on a drop of water, warm gently to expand them and drain off the excess.

Lay the slides out flat in the paraffine oven. At the end of one hour remove them. After they have cooled, put them in xylol to dissolve the paraffine and proceed in the usual way to stain and finish them.

Excellent slides have been made by this method. If quicker results are desired, cut the tissue in smaller pieces. If larger pieces must be used, allow more time for the infiltration of acetone and paraffine.

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SPECIAL ARTICLES

FURTHER EXPERIMENTS ON CORTICO-ADRENAL EXTRACT: ITS EFFICACY BY MOUTH

A RAPIDLY accumulating mass of evidence indicates that extracts of the adrenal cortex which have recently been developed are markedly potent in both experimental and clinical cases of adrenal insufficiency. The methods of Hartman and his associates[1] and Swingle and Pfiffner[2] have been widely used. In experiments reported from this laboratory full support has been given to the observations of the Princeton workers. We have employed a slightly modified Swingle-Pfiffner technique as described.[3]

Cortico-adrenal extract maintains completely adrenalectomized animals in good health for indefinitely long periods. It readily abolishes the severe symptoms of adrenal insufficiency when allowed to develop, and concurrently restores the blood sugar and non-protein nitrogen levels to normal.

Augmentation of the blood sugar to the normal value occurs in adrenalectomized cats showing symptoms within one to three hours after the extract is given. The increase is approximately proportional to the amount of the material injected; it is produced consistently and repeatedly when potent extracts are used. We have observed the effect at least five times within about ten days in the same adrenalectomized animal.

Cats with severe symptoms of adrenal insufficiency invariably show low blood sugar values. In over thirty cases in our experience, cortico-adrenal extract has raised the sugar percentage to within normal limits or higher. Notable increments in blood sugar also occur in unoperated cats, particularly if young animals are used. Biological assay of the extract based on the observed blood sugar effects is suggested from these results.[4]

The decreases in blood non-protein nitrogen, following extract injection, have not been so characteristic in our experiments. They usually occur more slowly than the glycemic changes, and sometimes are long delayed. These differences are possibly referable to the renal condition (damage?) in the different animals, and also to the fluid content of the tissues. In some cases there is considerable urination following extract administration.

Intraperitoneal injections of pituitrin, ephedrine and ergotamine solutions, known to influence the blood sugar in insulin hyperglycemia and other conditions, do not affect significantly the low blood sugar levels or the symptoms of adrenal insufficiency.

The administration of cortico-adrenal extract has been tested by mouth in a series of animals. The large doses which were found to be necessary, and the relatively small supplies of the extract available, as well as the considerable expense of the material, has somewhat curtailed our observations. Cats have been kept alive by oral treatment, however, for two weeks *after* severe symptoms (convulsions) of adrenal insufficiency became evident. Death rapidly fol-

[1] F. A. Hartman, K. A. Brownell and W. E. Hartman, *Amer. J. Physiol.*, 95: 670, 1930.

[2] W. W. Swingle and J. J. Pfiffner, *Amer. J. Physiol.*, 96: 153, 1931.

[3] S. W. Britton and H. Silvette, SCIENCE, 73: p. 322, March 20, 1931; *Ibid.*, p. 373, April 3, 1931; *Amer. J. Physiol.*, 97.

[4] S. W. Britton and H. Silvette, *Amer. J. Physiol.*, in press.

lowed withdrawal of the extract. Complete recovery from the convulsions which usually immediately preceded death was readily brought about, in several cases in the same animal.

The low blood sugar, high non-protein nitrogen and increased blood cell volume are restored to within normal limits when the extract is given by mouth. All the effects which were produced by oral administration were in keeping, indeed, with those which resulted from intraperitoneal injection of the material. Approximately three to five times the intraperitoneal dosage was necessary to produce comparable results. It is definitely clear from the experiments. however, that the effective hormone of the adrenal cortex is not wholly if at all destroyed in its passage through the gastro-intestinal mucous membrane.

Numerous attempts to maintain the lives of adrenalectomized cats by feeding whole and demedullated adrenal glands have not to date been successful. The animals do not readily eat the glandular tissue; if they are forcibly fed, vomiting often follows.

Adrenalin given by mouth in similar concentration to that present in the cortical extract which was used had no noteworthy influence on adrenal insufficiency. Glucose solutions given orally were also without significant effect.

The development of a method by which potent extracts of the adrenal cortex can be consistently produced suggested that tests of extracts of other tissues be made. Knowledge that specific chemical agents or hormones may be separated from widely different body tissues, and also that certain characteristics of the adrenal cortex find a resemblance in other extra-adrenal tissues (*e.g.*, the brain and testes), gave some hope of success in these experiments. Extracts were made of the following tissues: testes, brain, liver, spleen, and heart muscle. The method of preparation of these extracts was in all details similar to that used concurrently in making potent preparations of the adrenal cortex. When the tissue extracts were tested on adrenalectomized cats showing different degrees of adrenal insufficiency, however, the results were in all cases wholly negative. No effects were observed on the muscular weakness or other symptoms, or on the length of survival after operation.

In a recent report[5] the striking influence of cortico-adrenal extract, in bringing about precocious sexual maturation in rats, has been pointed out. Maintenance of the lives of adrenalectomized animals and the effects on sexual maturity—two apparently widely-separated functions—which are brought about by cortico-adrenal extract indicate the presence in the material of two distinct chemical agents or hormones.

It is suggested that the primary action of the life-preserving hormone of the adrenal cortex, which is effective in conditions of adrenal insufficiency, is concerned with preservation of the normal carbohydrate balance in the body.

Observation that animals from which the adrenal glands have been completely removed may be kept alive with extracts of the cortex indicate the dispensability but not the inutility of adrenal medullary secretion.

SUMMARY

Increase of the blood sugar which invariably follows administration of cortico-adrenal extract to adrenalectomized cats with symptoms of insufficiency is a reliable index of potency and affords a means of bio-assay of the material.

Cortico-adrenal extract is effective when given by mouth. The lives of adrenalectomized animals are prolonged and all the signs and symptoms of severe insufficiency are rapidly abolished by oral administration of large doses of the extract.

Extracts which have been prepared similarly to cortico-adrenal extract from many different (extra-adrenal) body tissues have no influence on the symptoms of adrenal insufficiency.

The existence of two hormones in cortico-adrenal extract is postulated.

S. W. BRITTON
H. SILVETTE[6]

UNIVERSITY OF VIRGINIA

VARVED CLAY IN HOLMES COUNTY, OHIO[1]

IN the course of field study of the glacial geology of Holmes County, Ohio, several deposits of layered glacial clay and silt have been discovered.

Holmes County is in northeast central Ohio. The region is one of maturely dissected upper Mississippian (Waverley) and Lower Pennsylvania (Pottsville and Allegheny) horizontal sediments. The usual relief is about 300 feet. The Late Wisconsin drift border crosses the county in a general east-west direction, except in the eastern portion, where the glacial boundary trends northeast-southwest. The farthest extent of the Late Wisconsin ice sheet is not well marked by a terminal moraine, except in some of the valleys which have their courses across the glacial boundary.

[5] E. L. Corey and S. W. Britton, SCIENCE, 74: 101–102, July 24, 1931.

[6] W. T. Porter Fellow in Physiology.

Grateful acknowledgement is made of aid received in the above investigations from the Grants-in-Aid Committee of the National Research Council.

[1] Published by permission of the Director, Geological Survey of Ohio.

Evidence is accumulating to show that the ice front retreated unevenly. Ice remained in the valleys for some time after it had melted from the hilltops. Such a condition was favorable for the formation of temporary lakes, not only in northward flowing valleys, but also in valleys flowing southward.

One of the lake deposits made up in part of varved clay is in southwestern Paint Township, in northeastern Holmes County, in the upper end of the valley of Middle Fork of Sugar Creek.[2] A well marked flat, now somewhat dissected by gullies to a depth of about 20 feet, is present on either side of the Mt. Hope-Winesburg road, two miles east of the first named village. The top of the terrace is approximately 1,110 feet above tide. A section of the material at the top of the terrace, measured in a newly excavated road-bank two miles east of Mt. Hope shows the following:

	Ft.	In.
Fine gravel	3	0
Sand	0	10
Sand and clay layers, fairly even, each layer about ½ to 1 inch thick	6	0

A short distance to the northwest, along a side road, about 10 feet lower than the deposits above, layered material resembling varved clay is present. It consists of evenly bedded sand layers about ¼ inch thick and layers of soft, soapy, bluish gray clay from 1 to 1½ inches thick. The clay layers contain thin streaks of sand about 1/64 inch in thickness. The clay layers can be separated along the thin sand partings.

Another deposit of layered clay was laid down in the southwestern part of Section Four, the southeast corner of Section Five and the northern part of Section Nine, Salt Creek Township, in the head of the valley of a small stream flowing southwest to Martins Creek.[3] This deposit is cut by the stream. The area is covered by irregular deposits of sand and gravel, giving a hummocky expression to the valley filling. The gravel and sand were probably washed into the lake after the deposition of the underlying clay and deposited around ice blocks. Along the road in central northern Section Nine, 20 feet of varved material is exposed. It consists of horizontal layers of clay and fine sand. The clay layers vary in thickness from ¼ to ½ inch, and the sand layers from one to two inches.

About three fourths of a mile to the northeast, in the southeastern part of Section Five, the relationship of the lake deposit to the underlying till is shown by the following section:

	Ft.	In.
Clay and sand layers, clay layers the thicker	7	0
Gravel, small pebbles	1	5
Boulder clay, yellow, containing cobbles to 6 inches	2	3
Boulder clay, hard, tough, grayish blue, silty	25	4

Some poorly exposed layered silt occurs in the valley of Martins Creek, one mile southeast of Benton, Salt Creek Township,[3] at an elevation of approximately 1,020 feet. To the northwest of Benton, kame terrace gravels overlie sand in which stratification is not well developed.

Layered clay is associated with the kame terrace on the eastern side of Killbuck Valley in the northern part of Millersburg, the county seat.[3] Clay four feet thick overlain by six feet of gravel is exposed at the end of North Grant Street. It is made up of layers ½ to ⅝ inch thick, separated by sand layers about 1/16 inch in thickness. The banding of this deposit may not be seasonal.

It is hoped that other deposits will be found and that sufficient data can be secured to correlate the deposits. A study of the till, and of the valley gravels, mainly of kame terrace type, is also in progress.

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[2] Shown on the Millersburg and Navarre topographic sheets of the United States Geological Survey.

[3] Millersburg sheet.

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